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THE PROGRESSIVE FISH CULTURIST

NEWS AND VIEWS FROM MANY SOURCES ON PRACTICAL HATCHERY PROBLEMS

ISSUED BY THE
BUREAU OF FISHERIES, U. S. DEPARTMENT OF COMMERCE

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Memorandum I-131 Washington, D. C. January, 1937. No. 26.

DISCUSSING THE PROBLEM OF THE PROPAGATION OF PACIFIC SALMON

By R. E. Foerster
Pacific Biological Station, Nanaimo, B. C.

IN A PREVICUS issue of THE PROGRESSIVE FISH CULTURIST it was my privilege to report upon a study of the natural and artificial propagation of sockeye salmon in British Columbia, as investigated by the Biological Board of Canada. In that article the methods of investigation, unique in many respects, were outlined in a general way and the results briefly described. I welcome now this opportunity of elaborating somewhat upon those results and of indicating their application generally, from a fish-culturist standpoint. The observations are offered, without prejudice, on the basis of the facts obtained.

The general findings of the investigation were that (1) the efficiency of natural propagation, as indicated by the number of seaward-migrating young leaving Cultus lake, ranged from 1 to 3 percent of eggs deposited -- probable percentage, 2.5; (2) artificial propagation involving fry distribution proved to be from 2 to 4 percent efficient whereas that based on eyed egg planting ranged from 1 to 4.5 percent; (3) since the percentages of efficiency for the three methods were not significantly different, in the statistical sense, therefore no method of propagation could be considered superior to any other in the production of young sockeye. In other words, since, as Dr. Calderwood, the eminent Scottish fishery authority, has so correctly pointed out, the value of artificial propagation is measured by the difference between natural propagation and the artificial measures devised by Man, rather than by the results of artificial propagation alone, the propagation of sockeye salmon in areas such as Cultus lake where natural runs of sockeye occur with good prospects for successful spawning is not improved by introducing artificial measures.

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In addition to these clear and illuminating results which may, however, not completely convince the whole body of fish culturists there are other circumtances intimately associated with the problem of artificial propagation which merit earnest consideration. These I propose to deal with under several heads below.

Extent of artificial propagation in relation to natural spawning in British Columbia

In any scheme of fish propagation the relation of the proportion of fish handled for artificial propagation to the total supply of spawning adults is of prime importance in assessing the extent of the benefits to be derived. Any system of artificial propagation should, to be effective, have an appreciable effect upon the fishery involved.

For a comparison of this type for the sockeye salmon the total number of eggs calculated to be contained in the estimated natural escapement to the spawning grounds have been computed for the three main river systems of British Columbia for the 15 years from 1918 to 1932 and are compared with the hatchery egg collections for the same period. The average yearly data may be tabulated as:

River system	Estimated Natural seeding (Millions of eggs)	Hatchery Egg collection (Millions of eggs)	Per cent of Egg collection to Natural seeding
Fraser	1,145	45	3.8
Skeena	778	16	2.0
Rivers Inlet	680	16	2.3

It is at once evident that the hatchery operations in British Columbia involve generally less than 4 percent of the probable natural seeding and can have but a very slight, if any, impression upon the fishery. The perpetuation of the fishery and the extent to which it can withstand a high fishing drain are dependent, and always have been, upon the extent of successful natural propagation.

Cost of Artificial Propagation

It is perhaps dangerous to enter into a discussion of the actual cost of propagating fish because so many economic factors are involved. However, looking at the matter purely from the fish cultural standpoint the folowing data concerning the artificial propagation of sockeye salmon may be considered.

From the Cultus lake investigation it has been found that from 2 to 4 percent -- roughly an average of 3 percent -- of the eggs contained in the spawning migration produce seaward migrants and further that approximately 10 percent of the seaward migrants survive to return from the sea as adults. From very 1,000 eggs therefore only 3 adults return.

An analysis of the costs of operation -- capital charges excluded throughout -- of hatcheries in British Columbia from 1921 to 1932, shows that the average cost per 1,000 eggs hatched and liberated as fry amounted to 99 cents. For the three most economically-run hatcheries on the Fraser river the average cost per 1,000 eggs was 82 cents. Using this latter figure as perhaps the more conservative one it follows that with 3 adults produced from each 1,000 eggs and at a cost of 82 cents, the production cost of each adult is approximately 27 cents. The market price for sockeye salmon, if such term may be applied to the price paid the fisherman by the canner or packer, ranges generally from 45 to 55 cents, varying from season to season and from river to river. For every adult sockeye reared artificially, therefore, practically one-half its market price was expended in producing it. This may seem a worthwhile profit but it must be remembered that the market price is, for the fisherman, his gross return and that costs of purchasing and operating boat and fishing gear and of living expenses must be deducted. Just what these charges amount to per sockeye is an intricate economic problem but needless to say they are appreciable and materially reduce the margin of profit which accrues to the country for its propagation endeavours.

Loss in Natural Egg Deposition and Fertilization

In the natural spawning of Salmonidae it was commonly considered that extremely heavy losses occurred during egg deposition and fertilization. This was generally held to be the weak link in natural propagation and it was to remedy such losses, chiefly, that artificial methods were initiated.

Although it is virtually impossible, either by experiment or by observation, to determine exactly the percentage loss in natural fertilization, those tests and observations which have been made definitely point to a high degree of success. Experiments with sockeye salmon at Cultus lake have shown a minimum survival to the eyed egg stage, among naturally deposited eggs, of approximately 75 percent, and tests conducted by the Dominion Department of Fisheries, to ascertain the extent of natural deposition and fertilization among sockeye partially stripped and subsequently liberated, have indicated an average survival of 65 percent.

These findings are in line with the opinions of Needham and Taft (Trans. Amer. Fish. Soc. 1934) for steelhead and the conclusions of Rutter (Bull. U. S. Fish. Comm. 1902) for Quinnat salmon -- the latter reporting over 80 percent successful natural fertilization -- and clearly indicate that the stage of egg deposition and fertilization is by no means the most critical one in the life history. In fact, when the losses which occur in artificial propagation due to (1) females dying during retention, (2) eggs remaining in the carcasses after stripping and (3) eggs being stripped in "green" condition are added to those losses occurring during incubation in the hatchery it is an open question whether these are not, in the aggregate, quite as high as would be found in normal natural spawning.

Losses Among Young Sockeye in Fresh Water, the Greatest Drain

From the Cultus lake studies it has been found that the mortality among young sockeye in the lake, between the fry and the seaward migrant stages, amounts to approximately 95 percent. This figure has been established from a number of counts of the total number of seaward migrants surviving from the liberation of known numbers of fry. Here lies the greatest loss, one which drastically limits, under present conditions, the efforts to build up the sockeye stocks. But is it beylnd the scope of some measure of control and of improvement? At present we feel that it is not. Researches indicate that predatory fishes are to a large extent the responsible agencies for the loss and two methods of attack are thereby presented, either removing the predators from the lake or removing the sockeye to protected waters. Both of these possibilities have been studied and may be briefly described.

Pond Rearing

Extensive tests of pond rearing have been made and it has been found that increased retention prior to liberation in the lake results in a correlated higher rate of survival For example, from experimental liberations and subsequent recoveries at time of seaward migration the percentages of survival according to period of residence in the lake increased in the following manner: 12 months in lake, survival - 5 percent; 9 months in lake, 21.8 percent; 7 months in lake, 32.8 percent; 5 months in lake, 44.6 percent; 3 months in lake, 54.7 percent. The retention in ponds thus materially reduced the degree of loss in the lake yet when the costs of rearing, quite exclusive of capital costs of pond construction, were taken into consideration the production costs per seaward migrant very closely balanced the increased survival, that is to say, the costs per seaward migrant were the same, whether liberated into the lake as fry, with a 95 percent mortality or after 9 months' retention with a mortality of 45.3 percent.

While the rearing costs in the experiments may have been somewhat higher than would prevail in a large-scale procedure it is believed that any appreciable reduction in cost, through cheaper diet or greater crowding of ponds, would lead to heavier losses and the end result would be no better. Finally the danger of infection and consequent serious depletion of the pond populations must be kept in mind. Sockeye are by nature not pond fish, they are essentially plankton feeders, open water residents, and suffer readily from confinement. For these reasons and from our experience we seriously doubt the advisability of adopting any system of pond retention for sockeye. Most certainly, any attempt to enter upon a large-scale scheme, sufficient to have any material effect upon the fishery would be a matter of great expense, both capital and operating, and fraught with danger.

Control of Predatory Fishes

With pond retention rendered extremely doubtful as a means of efficiently improving artificial propagation of sockeye the other alternative, removing the predatory fishes, was investigated. The species involved (especially Dolly Varden),

principally char, squawfish and trout, are being systematically netted from Cultus lake and even though the destruction has proceeded but a short time the evidence concerning increased survival of sockeye in the lake is distinctly encouraging. The real extent of the increase is being carefully assessed.

Conclusions

In conclusion the problem of the propagation of sockeye salmon in particular and the implication in relation to the propagation of other species may be expressed in this manner:

(1) Artificial propagation has not been proven to be superior to natural spawning in producing seaward migrants. Even were it better, due consideration must be given the following facts - (a) artificial propagation represents but a small percentage of the natural seeding of any river system and chief reliance for the perpetuation of the fishery rests on natural spawning, (b) on the basis of the present data, the cost of rearing young salmon represents approximately one-half of the market value and a considerably larger portion of the value of the fish in the water, before the costs of the fishing effort are added. These costs have been conservatively estimated and any system of artificial propagation involving numerous hatcheries, frequently in outlying areas, will, of necessity, be more expensive and therefore less economical from the general point of view.

(2) Natural propagation has been shown to be the mainstay of the fishery and requires, for continuous success, only a suitable spawning escapement. The natural seeding is found to be quite as efficient as liberation of fry from hatcheries or the planting of eyed eggs and can be measurably increased by improvement of spawning grounds, protection of spawning adults and stream water control. Greatest benefit can be derived by reducing the heavy mortality in the nursery lakes and if, as evidence indicates, the reduction of the populations of predatory fishes can decidedly reduce this mortality, efforts along these lines will be indubitably worthwhile.

Artificial propagation becomes, as it was originally meant to be, an emergency measure for use in those situations in which, through changing conditions, severe reduction of the spawning stock, etc., the natural seeding is found to be deficient or lacking. It cannot, for sockeye and probably for a great many other species of commercial fishes, replace natural spawning except at a certain cost. It becomes necessary, therefore, to consider this cost, not in relation to the hatchery output, but to the end-product, the production of adult fish. In every case the value of artificial propagation is measured primarily by the difference in results between it and the natural method and further, we urge, between it and the natural method after the latter has been subjected to all the logical improvements economically possible.

Natural propagation has never received the critical attention necessary to reveal its true efficiency. It has suffered through preconceived opinion, misconception of its value, over-enthusiasm for hatchery operation and many other factors. A careful investigation should be made before any fishery, particularly commercial,

is subsidized at public expense by the utilization of artificial propagation. And even when so subsidized, the value of the investment should be searchingly reviewed and clearly revealed.

SIMPLE METHODS OF MEASURING FLOW OF WATER

By A. L. Anderson
United States Forest Service

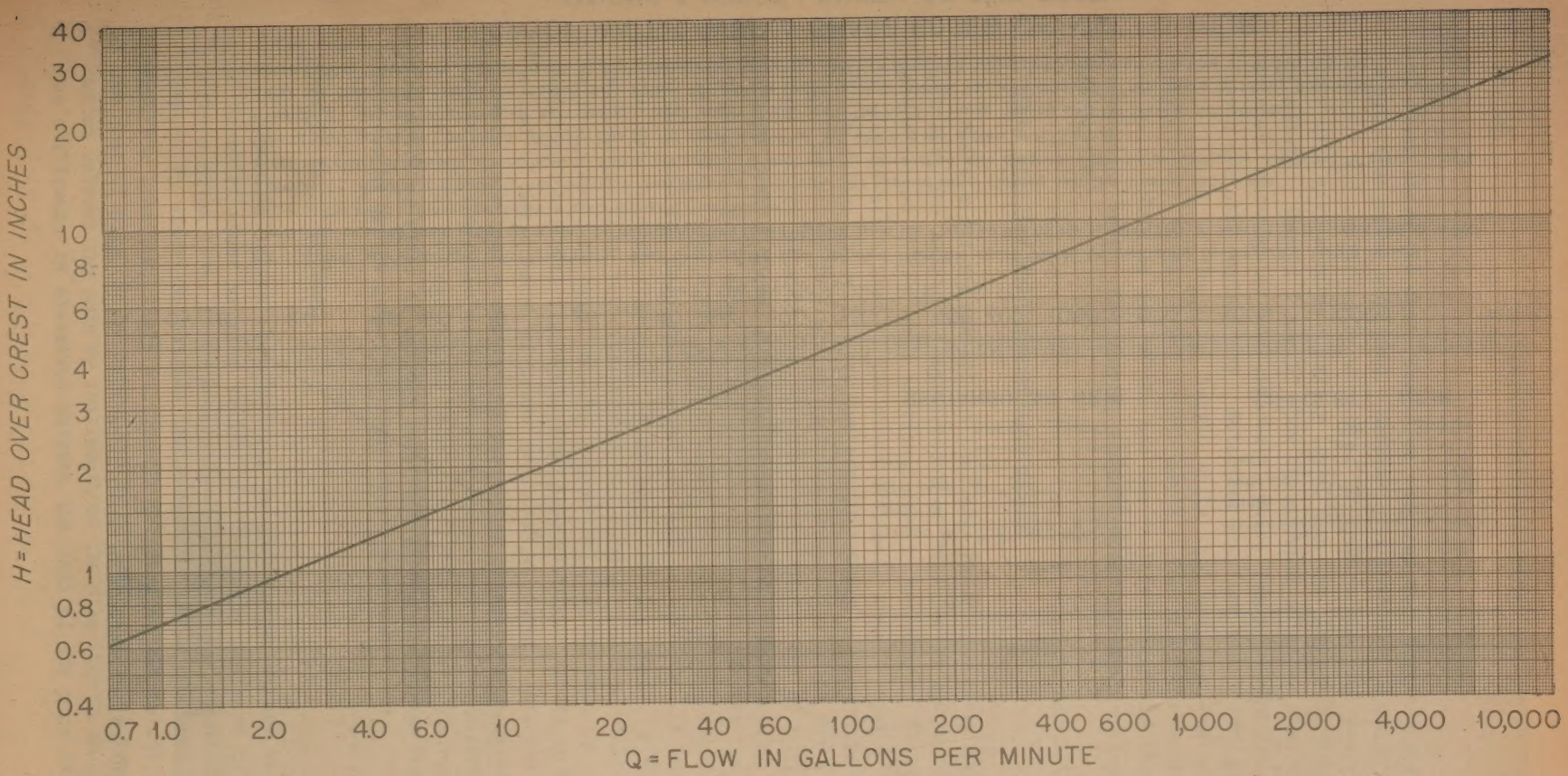
IN MEASURING the flow of springs or streams, it should be remembered that the flow will vary considerably during the different seasons of the year and also from year to year. Where water supply improvements are to be constructed, it should be determined that the supply will always be adequate for the satisfactory functioning of such improvements. Therefore, before constructing a water system of any sort, it is desirable to obtain a series of measurements for as many years as possible. Where it is necessary to construct on the basis of one or two measurements, the opinions of local residents will often be of value in determining the probability of the flow diminishing below that at the time of measurement.

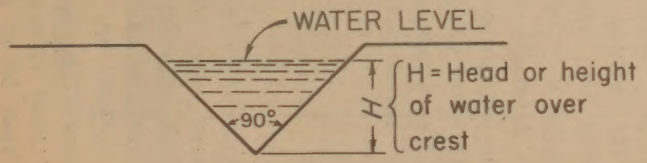
Small Springs

The simplest method of measuring the flow of small springs is to place a pipe or trough in the spring and run the water into a can or other container the capacity of which is known. The capacity of the container in gallons, divided by the time required to fill it in minutes, will give the flow in gallons per minute.

Use of Weirs

Where the stream is too large to divert into a container, the best means of measurement is with a weir. Weirs are commonly of three types; (a) 90° triangular or V-notch, (b) rectangular, and (c) cippoletti type, which is a trapezoidal weir with the sides sloping away from the crest on a ¼ to 1 slope. The triangular weir is suitable for the measurement of small streams whose flow does not exceed 1,000 gallons per minute. The rectangular and cippoletti weirs are suitable for larger streams. Weirs for the measurements of water should be sharp-crested. If they are constructed of wood, the edges should be bevelled, on the down-stream side. Weirs constructed of sheet metal give an ideal crest. A weir should be so placed in the stream that a pool of water will be formed on the up-stream side, which will reduce the velocity of approach to a relatively small amount. The weir itself should be so installed that there will be no appreciable amount of seepage around or under as the only water measured is that which flows over the crest. The "head" or the height





Example: Assume water flowing over weir at height of 3.5 inches Enter diagram at left opposite 3.5: follow line horizontally to right to intersection with diagonal. Then follow vertically downward where flow of 54 g.p.m. will be read on bottom scale of chart.

FLOW OF WATER OVER A SHARP EDGED 90° TRIANGULAR WEIR

(Based on formula $Q = 2.52H^{2.47}$)

CHART I

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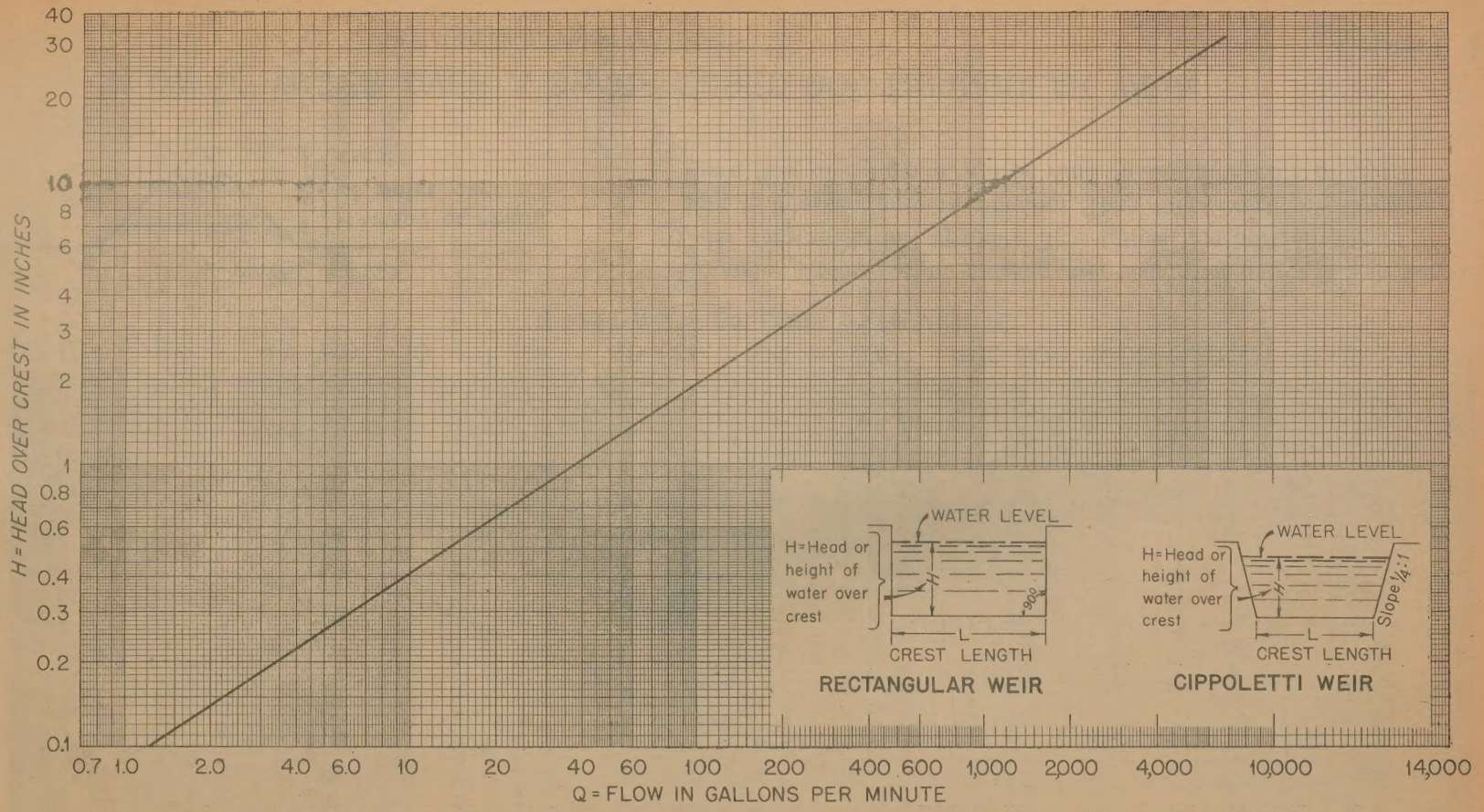


For cippoletti weirs having a crest length other than one foot, the flow obtained from the chart should be multiplied by the crest length in feet.

Chart may be used for a rectangular weir by multiplying the flow obtained from the chart by the factor (L-0.017H), in which L is the crest length in feet and H is the head in inches as shown in accompanying illustrations

Example 1- Assume a cippoletti weir having a crest length of 2.5 feet. The head of water flowing over the crest is 4.5 inches.

Enter the chart at the left at reading 4.5. Follow horizontally to the right to intersection with diagonal. Then follow vertically downward to bottom where flow of 350 g.p.m. will be found. Multiply this by the crest length of 2.5, which gives a flow of 875 g.p.m.

Example 2- Assume a rectangular weir having a crest length of 2.0 feet. The head of water flowing over the crest is 3.5 inches.

Enter the chart at the left at the reading 3.5. Follow horizontally to the right to intersection with diagonal. Then follow vertically downward to bottom where flow of 240 g.p.m. will be found. Multiply this by the factor (L-.017H) = (2-.017X3.5) = 1.940, which gives a flow of 465.6 g.p.m.

FLOW OF WATER OVER A SHARP EDGED CIPPOLETTI WEIR HAVING A CREST LENGTH OF ONE FOOT

(Based on formula $Q = 3.367 LH^{1.5}$)

CHART II

of water above the crest should be measured at a distance upstream from the weir of about three times such head. However, for obtaining the approximate flow it will be easier, and sufficiently accurate, to measure the head directly at the weir notch. This will give a value slightly lower than the true head, which error is on the side of safety. Charts I and II show the amounts of water that will flow over the triangular, rectangular and cippoletti weirs respectively, for various heads. These charts are self-explanatory. Note that the flow over the cippoletti weir is directly proportional to the crest length while that over the rectangular weir is directly proportional to the crest length minus a factor of the head or height of water on the weir. This is due to the end contractions caused by the vertical edges of the rectangular weir. The sloping ends of the cippoletti weir compensate for this end contraction.

Channel Velocity and Cross-section Method

Where a stream channel is too large to conveniently install a weir, the next most accurate method is measurement of velocity by means of a current meter, and determination of the cross sectional area by soundings. The average velocity in feet per second multiplied by the cross sectional area in square feet will give the flow of the stream in cubic feet per second. Where a current meter is not available, a simple method of determining approximate velocity is to use a surface float. Simply throw a piece of wood into the middle of the stream at a fixed point and time its passage over a known distance of the stream. This method will give the surface velocity which is usually from 1.05 to 1.33 times greater than the mean velocity for the channel. Where the channel is not more than 2 feet deep, the factor 1.33 should be used and for deep channels of 10 feet or more the factor 1.05 should be used. Thus, for a deep channel, the average velocity would be considered equal to the measured surface velocity divided by 1.05 and for a shallow channel the average velocity would be equal to the surface velocity divided by 1.33. For intermediate depths proportional figures between these extremes should be used. In applying this method of measurement of cross sectional areas and velocity in channels it is desirable to select a section of the stream channel which is as smooth and uniform as possible. The cross sectional area can be obtained by multiplying the width of the stream by the average depth. A simple way to obtain the average depth is to measure the depth of water at uniform intervals across the stream bed and divide the sum of such depths by the number of measurements plus one.

Flow of Water in Pipes

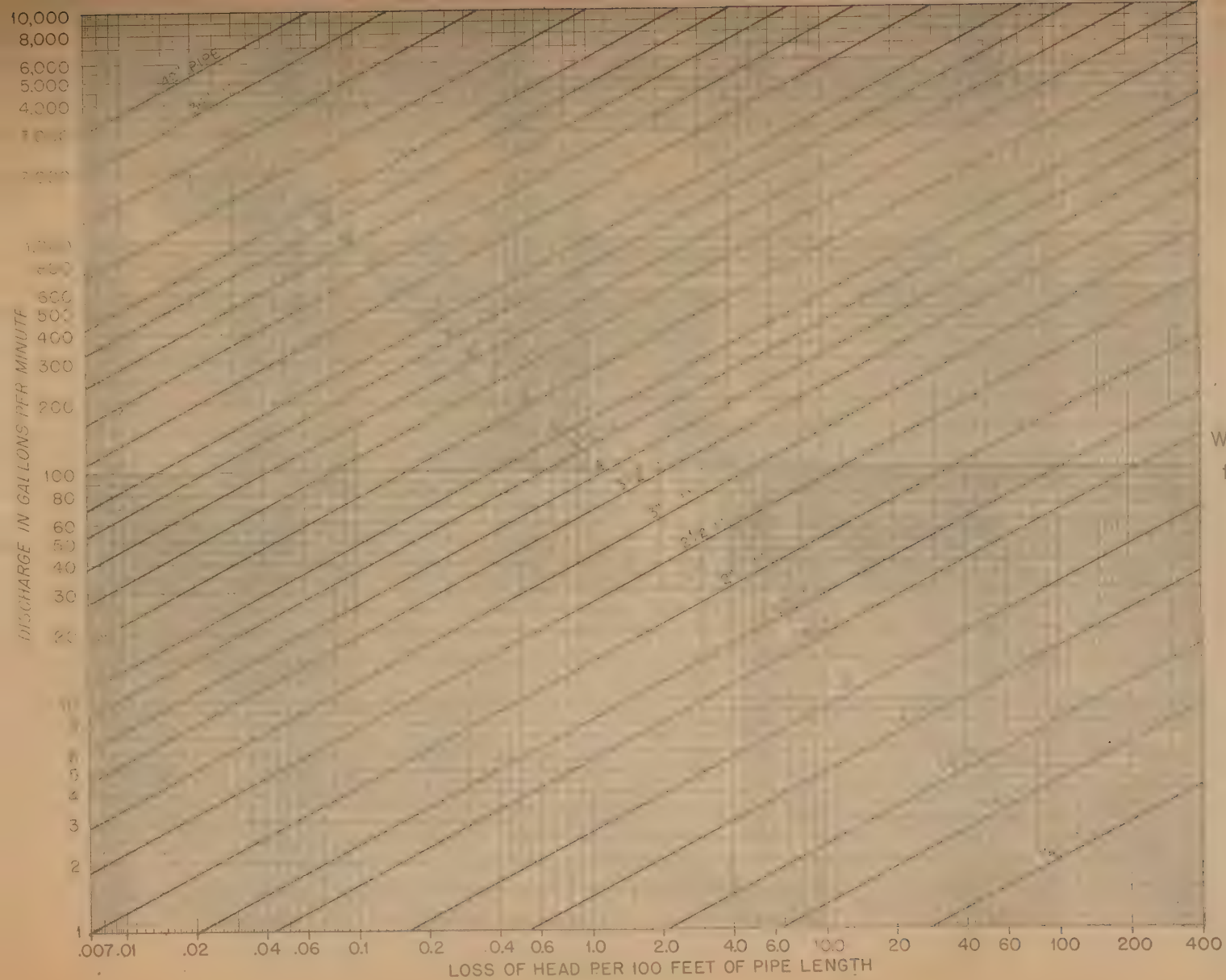
Chart III gives the discharge in gallons per minute for pipes from ¼" to 42" in diameter under varying heads. To determine the size of the pipe necessary to carry a given flow, it is necessary to measure the length of the pipe and the difference in elevation between the ends. If the total head is to be used for pipe friction (that is, there will be no pressure at the outlet), the loss of head per 100 feet of pipe can be determined by dividing the total head or difference in elevation between the ends by the length of the pipe line in hundreds of feet. Thus, if the difference in elevation between the ends of the pipe line is 50 feet, and the

length of the line is 1,000 feet, the loss of head, or the head available for pipe friction per 100 feet will be 50 divided by 10 which is 5 feet. Assuming further, that the desired flow is 200 gallons per minute, the size of pipe necessary is determined as follows: Enter Chart III at the bottom, opposite a loss of head per 100 feet of 5.0. Follow vertically to the intersection with the horizontal line opposite discharge of gallons per minute of 200. This intersection will fall between the diagonal lines labelled, 4" pipe, and 3½" pipe. This means that a 3½" pipe will be too small and a 4" pipe will be slightly too large. In such a case a 4" pipe would probably be used; or if extreme accuracy is desired, a combination of 3½" and 4" pipe could be obtained which would give the exact flow required. If it is desired to reserve 20 feet of head at the discharge end of the pipe for pressure at hydrants or other purposes, only 30 feet will be available for pipe friction. This will allow only 3 feet per 100 feet of length. Referring to Chart III it will be found that a combination of 4" and 4½" pipe will be necessary to deliver 200 gallons per minute.

If the head and size of pipe are known, Chart III may also be used to determine the amount of flow. For example, assume that it is desired to determine the amount of water discharged by a 4" pipe having a length of 200 feet under a head of 10 feet. First compute the loss of head per 100 feet of length. This is 5 feet. Then enter Chart III at the bottom at the reading of 5.0; follow vertically to intersection with diagonal line labelled 4" pipe. From this intersection follow horizontally to the left hand scale where a discharge of 215 gallons per minute will be found.

Flow of Water in Flumes

Chart IV may be used to determine the velocity of flow in flumes. This chart is based on a value of n = 0.014 as used in Kutter's Formula. This is the usual value of n for flumes of painted metal, wood stave construction or concrete. It allows for some curvature or a small amount of silting or algae growth. To determine the velocity of flow in a given flume by means of Chart IV, it is necessary to measure the cross sectional area of the flume below the water surface and the slope or gradient of the flume. The slope should be expressed in decimal form equal to the length in feet divided by the difference in elevation for this length. In measuring the cross section area the wetted perimeter should also be determined. The wetted perimeter is the distance around the cross section where the water is in contact with the flume. Thus, for a rectangular flume 2 feet wide and water 1 foot deep, the wetted perimeter would be 4 feet. Having the wetted perimeter and the cross sectional area, the hydraulic radius can be determined by dividing the cross sectional area by the wetted perimeter. Thus, in the above example the cross sectional area of the flume would be 2 square feet. Dividing this by the wetted perimeter of 4 gives a value of 0.5 for the hydraulic radius. To determine the velocity of flow in this flume, enter Chart IV at the left-hand side opposite the value 0.5 for hydraulic radius, follow horizontally to the right until the line corresponding to the slope is intersected. For this example assume that the slope is 0.006. At the intersection of the horizontal line for hydraulic radius 0.5 and the diagonal line for slope 0.006, follow vertically downward where the velocity of 6.5 feet per second will be found at the



FLOW OF WATER IN PIPES

Based on Williams and Hazen formula for value of C=100

CHART III

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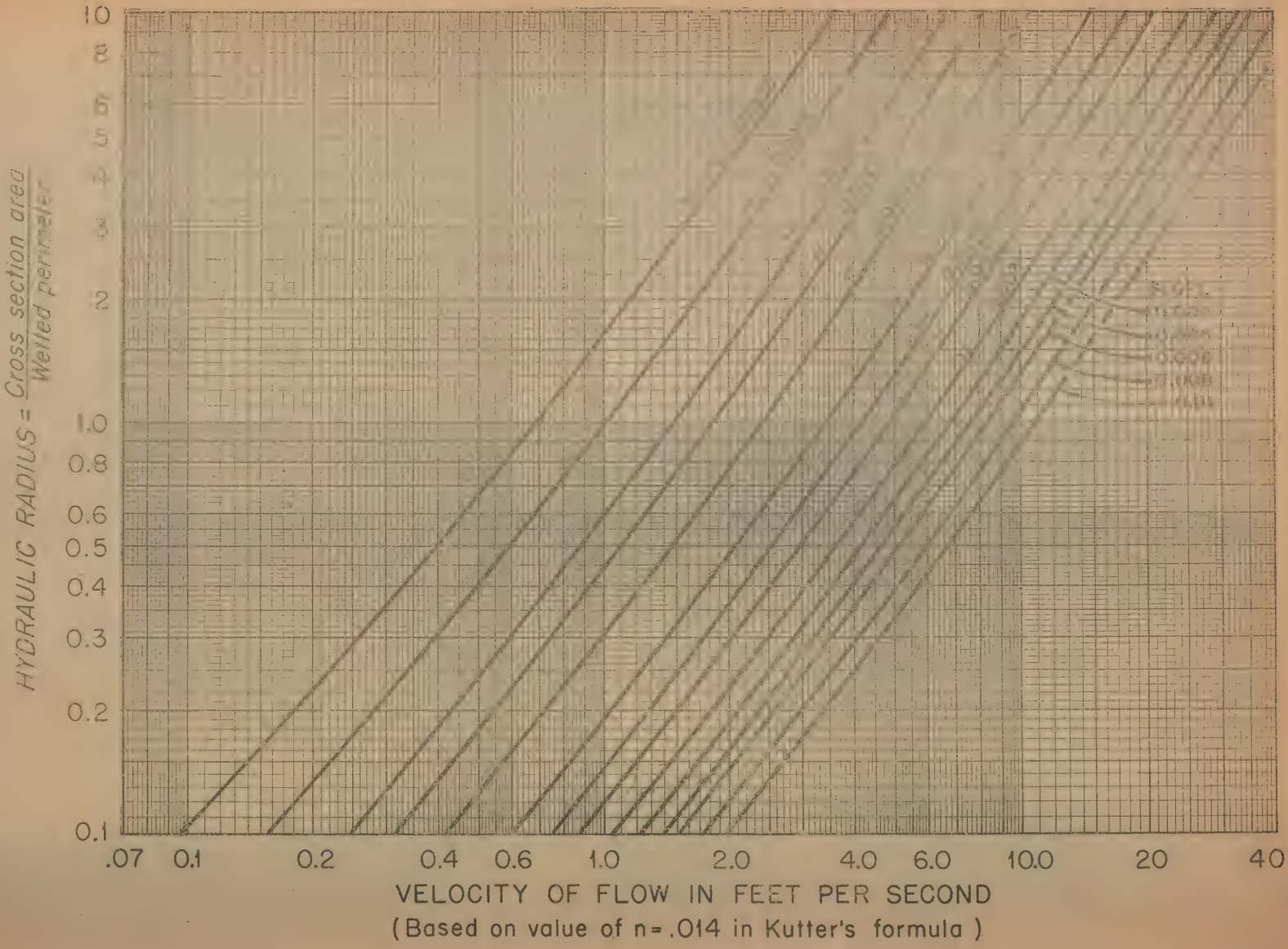

FLOW OF WATER IN FLUMES CHART IV

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bottom of the chart. To determine the amount of water flowing in the flume, multiply this velocity by the cross sectional area in square feet which in this example gives a flow of 13.0 cubic feet per second. If the flow in gallons per minute is desired, multiply by 450 which is approximately the number of gallons per minute in one cubic foot per second. This gives 5,850 gallons per minute.

The cross sectional area of a semi-circular flume flowing full is equal to half the area of a circle. This is $\frac{Pi\ R^2}{2}$ where R = radius and Pi = constant 3.1416. The wetted perimeter of such a flume is equal to Pi R which is half the perimeter of a circle. The hydraulic radius then becomes $\frac{R}{2}$ or one fourth of the diameter. For a given area the semi-circle is the most efficient of all cross sections. For any type of cross section the most efficient discharge is obtained when the hydraulic radius is equal to half the depth of the water.

TOO MANY FISH

By R. W. Eschmeyer
Institute for Fisheries Research, Ann Arbor, Michigan

WITH ANGLERS constantly requesting more and more stocking and with our hatchery facilities constantly being expanded to meet their demands, the title to this brief discourse sounds a bit -- well, "fishy". There is reason to believe, however, that the expression will become more common as time goes on.

Increasing evidence indicates that while fishing in some waters can be improved by stocking, fishing in other waters could be bettered not by adding fish for maintenance but by removing some. And it seems that waters of the latter kind are not so uncommon as might be supposed.

In recent years the Institute for Fisheries Research has been removing perch from several potential trout lakes by poisoning, coupled with heavy dynamiting. The dead fish were collected and studied. One of the populations was especially interesting because it represented extreme overcrowding. These fish were discussed in some detail at the last meeting of the Michigan Academy of Science, Arts and Letters, but it might be well to recount here some of the information obtained from an examination of these stunted fish.

The population in question was removed from South Twin Lake, Otsego County, Michigan in September, 1934. South Twin Lake has an area of 4.3 acres, a maximum

depth of 42 feet, a sandy margin and mucky bottom over most of the lake. It has a relatively circular outline and is bowl-shaped, with very limited shallows. It has no inlet or outlet.

Not all of the dead fish were recovered, but there is reason to believe that a big majority of them were seen and collected. Except for about a half dozen brook trout which had been previously planted, the fish were all perch. A total of 3,615 perch were recovered and 503 were counted lying on the bottom after the last collection was made.

All the perch removed were measured, weighed and sexed, and the age and rate of growth determined. This information is given in the table below. Since the fish were taken in mid-September, they were really almost one full growing season older than the figures show.

Winter Marks	0	I	II	III	IV	V	VI	Over VI
No. of females in each age group:	2	28	1238	99	141	18	1	2
No. of males in each age group:	1	71	1536	383	94	.....	.....	.....
Total (both sexes)	3	99	2774	482	235	18	1	2
Av. total length in inches: females	2.1	3.8	4.1	5.9	6.3	7.9	12.5	13.8
males	2.0	4.2	4.0	5.5	5.7	.....	....	....
Av. weight in ounces: females	.09	.27	.34	1.07	1.25	2.70	15.73	15.65
males	.08	.40	.37	.77	.89	.....	.....	.....

Over three-fourths of the fish were in the II group, i.e. they were three summers old. They had an average length of only 4 inches and weighed about a third of an ounce each. There were only 3 fish in the 0 group and only 99 in the I group. The oldest group of males (5 summers old) had an average length of less than 6 inches, the legal size for perch in Michigan. These relatively old perch averaged less than an ounce in weight. The females grew faster and lived longer. Seven percent of the fish (54 males and 199 females) were of legal length, but many of these could not be considered of eatable size because they were almost literally "skin and bones".

The fish definitely accounted for represented a total of 955 per acre, having a total weight per acre of approximately 30 pounds.

The fish in age groups III and IV were, mostly, in very poor condition and had unusually large heads. The more emaciated ones had apparently resorbed part of their

scales, had very small stomachs and very small (perhaps partially resorbed) sex organs. The only food present in abundance in the stomachs consisted of small insect larvae and small Cladocera, Daphnia, etc. and perch of the II group. The only larger fish which were in good condition were the few that had grown big enough to eat the 4 inch perch, which were abundant. There appeared to be very little food of intermediate size. It may be safely concluded that most of the fish in this lake normally died of starvation before they reached a "catchable" size.

While the population was still present, few of the perch were normally seen swimming near the surface. A fisherman using minnows of average size as bait would not have caught many fish. He might logically have inferred that the lake needed stocking with more perch. Under the circumstance, the fish culturist, too busy to carefully examine each lake in his area, might, without discredit to himself, oblige by adding a few cans.

This population probably represented an extreme situation, but the Institute's surveys indicate that stunted fish, especially perch, are not uncommon.

Eventually, when stocking is based on rate of growth, the answer to the question of where to plant the fish will become much less difficult than it is at present and we will no longer, figuratively speaking, add more sheep to those pastures which are already badly over-grazed. We might, though, add the fish equivalent to sheep-killing dogs — pike perhaps.

THE NORTH CENTRAL STATES WILDLIFE CONFERENCE

By John Van Oosten
In Charge, Great Lakes Fishery Investigations

THE NORTH CENTRAL States Wildlife Conference held its second annual meeting at Ann Arbor, Michigan, on December 10, 11, and 12, 1936. About 200 conservationists and naturalists attended representing the States of Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Missouri, Iowa, North and South Dakota, and the various conservation bureaus of the Federal Government. Some 50 topics concerning wildlife management were discussed during the first two days of the session while the third day was devoted to an inspection of the various University of Michigan properties near Ann Arbor.

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The conference, which has no elected officers or members, was formed at Urbana, Illinois, in December, 1935, "to provide an opportunity for discussion of matters concerning wildlife management, to facilitate the exchange of views on controversial questions, to disseminate information on current research projects and to focus attention on important conservation problems".

Attendance is drawn from various sources -- state conservation departments, universities and colleges, the U. S. Bureau of Fisheries, the U. S. Biological Survey, the U. S. Forest and Soil Conservation Services, the Resettlement Administration, and individuals directly interested in conservation work.

The Ann Arbor conference was opened with an address of welcome by Dr. Alexander G. Ruthven, President of the University of Michigan. This was followed by a series of informal discussions devoted to the general problem of harmonizing real and imaginary conflicts in wildlife management. The following topics were considered: the relative values of established management practices and new techniques for game mammals and birds, maximum populations versus healthy stock, the conflict between clean agricultural practices and wildlife survival, game laws versus sustained yield cropping, the beaver - trout controversy, and timber production and woodland improvements versus wildlife.

The Thursday afternoon session was divided into two discussion groups; one group considered the general problem of management of game birds and mammals in agricultural areas, the other the question of inventories of lakes and streams. P. S. Lovejoy of the Michigan Department of Conservation introduced the first topic considered by the latter group and discussed the need of a water classification as the basis for fisheries survey and management. He pointed out that the classification of soils proved of great value in the work of the Michigan Land Economic Survey and felt certain that a similar classification of the various types of waters would facilitate the "pigeon-holing" of data obtained by fisheries surveys and used for management purposes. Dr. A. S. Hazzard of the Michigan Fisheries Institute discussed briefly the methods and scope of stream and lake surveys. Dr. Frank Eggleton of the University of Michigan led the discussion on limnological studies of type waters pointing out the possible bearing of such studies, especially the one on productivity, to fisheries problems.

The broad subject of fish populations of type waters was discussed in relation to densities, migrations, growth and yields. Mr. R. W. Eschmeyer described the methods used (dynamite and poison) to determine the densities of fish populations in certain Michigan lakes and stated that although his results were still preliminary in nature he could report definitely that a population of 1,000 yellow perch to an acre was too dense since this concentration produced dwarfed individuals. Mr. David Shetter outlined the various tagging methods employed to study the migration of brook trout in Michigan streams. Dr. H. J. Deason of this Bureau discussed the relationship of growth studies of fishes to fisheries surveys and management. A limological study of lakes and streams is not a reliable index of the growth rate of fishes. Apart from temperature and availability of food, other relationships such

as population pressure, predators, and the "inherent capacity for growth" of each species are important determiners of growth rate. The number and relative abundance of age groups in a population is the best index of the stability or instability of a species. Dr. Ralph Hile of this Bureau presented a discussion of the question of yields from lakes and streams. While a measure of the yield of waters which support a commercial fishery can be obtained with relatively high accuracy it is difficult to measure the yield of inland lakes fished exclusively by sportsmen. A knowledge of the yield per fishing hour for any body of water, secured over a period of years will provide some idea of the abundance of the principal species. A continuous creel census program is the best means which has been developed for obtaining this information. Experience has demonstrated that a knowledge of the physical, chemical, and biological conditions of a body of water provides no adequate basis for predicting either the growth rate or the yield of a species.

Professor George La Rue of the University of Michigan introduced the subject of parasites of fish. The field of fish parasitology is just being opened up and although the practical value of parasitological studies to fish management is not yet clearly evident there would seem to be little doubt that with an expanded program such studies will develop a more clear-cut practical phase.

The general session held on Friday morning was devoted to problems of wildlife inventory. A free-for-all discussion was held on such topics as the philisophical basis of inventory, practicable limits of inventory, and the application of inventory information in management. The afternoon session was again divided into two groups, the section on birds and mammals discussing the special problems concerned with management practices as applied to forest wildlife.

Dr. John Van Oosten of this Bureau opened the afternoon session on fish with a discussion of "The Stocking Needs and Policies on the Great Lakes". Stocking problems on the Great Lakes cannot be solved by the same techniques employed on smaller bodies of water. Both the size of the lake and the magnitude of the fish populations prevent this. While inland stocking is done principally by means of planting fingerlings or larger fish, fry only are planted in the Great Lakes. The cost of rearing a sufficient number of fingerlings for stocking the Great Lakes would be prohibitive.

With respect to fish cultural policies on the Great Lakes there is a sharp difference of opinion among the various governments involved. The policies in operation in various areas include: A strictly closed season during spawning with all ripe fish caught during the open season being stripped for the hatcheries; a closed season with permits issued to certain fishermen to obtain spawning fish which are stripped for the hatcheries; no closed season but all spawn collected under official supervision; a closed season and adequate regulation by size limit to protect spawning females; and no definite policy. It is alarming that such disagreement exists after 50 years of fish culture and stocking. We should have critical data on this question by now — but we don't!

The uncertainty is due to lack of data on fundamental points: (1) The number of eggs produced and fertilized in nature. (2) The percentage of eggs hatched and

the percentage survival of fry in nature. (3) The percentage survival of hatchery produced fry after planting. (4) The relationship of the number of fry planted and the yield are obscured by many unknown factors. These problems need to be studied if we are to judge with any accuracy the effectiveness of any stocking policies as compared with natural propagation.

Progress in acquiring some of this fundamental information is being made. The contention of older fish culturists that only one percent of the eggs spawned in nature survive to the fry stage is erroneous. Actual data on several important fresh-water species collected in North America and Europe have shown the percentage to be much greater. For example, a sample of lake trout eggs collected from the bottom of Lake Michigan showed 36 percent fertilization. Similar experiments on other fish gave the following results: Whitefish, 62 and 100 percent; yellow pike-perch, 22 percent; Pacific salmon, 66 to 96 percent; blue whitefish of Europe, 80 percent. A recent study by Dr. Hile demonstrated the absence of correlation between the number of yellow pike-perch fry planted in certain waters and the subsequent yield of the commercial fishery. The effect of strictly closed seasons in Michigan waters on the population of lake trout and whitefish cannot be determined until the plan has been in operation for a longer time. The reliable catch statistics of the commercial fishermen of the Great Lakes which are now being obtained will help to answer some perplexities.

Messrs. A. B. Cook and Milton Trautman discussed the stocking policies with reference to inland waters. It was brought out that certain waters were stocked regularly although fish were plentiful and such stocking was therefore not justified. Better and more knowledge should be obtained of waters that are stocked.

Messrs. Clark Salyer of the Biological Survey and G. W. Bradt of the Michigan Department of Conservation, led the discussion on predators and competitors confining their remarks largely to the relation of the beaver to trout in Michigan waters. Both investigators agreed that although the trout was the more valuable asset to the state financially there was no reason why, with proper management, both trout and beaver could not flourish in the same region. The problem does not warrant the tremendous publicity that has been given it. The question of pollution was introduced by Mr. Milton P. Adams, executive secretary of the Michigan Stream Control Commission, who outlined the Michigan program of control and the recent progress made by the municipalities and industrial concerns, especially in the newly developed oil fields, in cleaning up Michigan streams.

The subject of environmental improvement brought on, as usual, considerable discussion. Mr. W. W. Aitken of Iowa reported on the work being accomplished in his State under the 25-year program. Professor W. F. Morofsky of Michigan State College, East Lansing, discussed the effect of stream improvement on the abundance of insects. He found that the insect population of the improved sections of a stream was on the average larger than that of the unimproved sections of that stream. The general discussions brought out the fact that no one has collected so far critical data on the most fundamental question as to whether stream improvement work actually increases the number of fish in a stream. Available information shows

that the fish of a stream undoubtedly redistribute themselves in order to make use of newly constructed shelters or the increased supply of food in these shelters, but whether the fish population of an improved stream has actually increased in numbers is still a mooted question.

The University Museums and the facilities of the School of Forestry and Conservation were available to the delegates during the evenings. A venison banquet was enjoyed on Friday evening. The 1937 meeting of the conference will be held at Madison, Wisconsin.

C O R R E C T I O N S, W I T H O U R A P O L O G I E S

Pacific Biological Station
Nanaimo, B. C.
January 19, 1937

Mr. Elmer Higgins, Chief
Division of Scientific Inquiry
U. S. Bureau of Fisheries
Washington, D. C.

Dear Mr. Higgins:

You have asked for it. When, as Editor of THE PROGRESSIVE FISH CULTURIST, you solicit contributions — not in coin of the realm but literary or should we say scientific — you must perforce accept the same responsibilities as the furniture dealer who advertised that he stood behind every bed he sold. In other words you take the blame for all the "i's" and t's" that are not dotted and crossed, respectively in your journal, if they were dotted and crossed in the original manuscript.

I know that from your experience as a fisheries researcher and your avowed love of practical fish culture you would want to see neither a fellow researcher hurt nor a fish culturist pained, but methinks you have unwittingly contributed to both in your release of my first contribution to your valuable journal.

If you will turn to page 6 of the December 1936, issue of the PROGRESSIVE FISH CULTURIST, line 30 from the top or line 9 from the bottom, you will observe the statement "and therefore no method can be made to be superior to the others". That is an extremely tall and dangerous ultimatum to make at any time and in any place and, shuddering as I read it and perceived the dire import, I rushed to my manuscript for confirmation or more properly -- refutation. My fears were justified for upon perusing that section of my article I find myself to have said "And therefore no method can be <u>said</u> to be superior to the other." The substitution, simple enough, of "made" for "said" makes a difference which is significant, statistically, culturally, acoustically, and in any of the modern languages.

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In spite of any results which my researches may have elicited concerning the fundamental merits of artificial propagation and the operation of hatcheries, I have a high regard for hatchery officers. They carry out their work to the best of their ability, conscientiously, with oft-times little expression of gratitude to reward them, and, as far as the actual hatchery operations are concerned, they themselves are now being conducted with a very high degree of efficiency. One of the very last things I would do, therefore, would be to insinuate that any method of propagation could not be "made" to be superior to others, especially since the matter of cost did not enter the picture in my article under discussion at all. On the other hand I would not care to say off-hand that natural propagation could not be "made" to be superior to other methods, in fact, my second article rather leans to that opinion.

Therefore, Mr. Editor, you have put me on the spot in a most uncomfortable state of mind and in a most compromising attitude and I respectfully request that you speedily take the necessary steps to get me off, relieve the tension, and restore those amicable relations which I have always had both with fish culturits and with Nature.

Having now, I hope, successfully dealt with matters of grave concern, may I digress a moment to say how delightfully refreshing it was to find embodied in your Editorial in the same issue as my article, a New Year's battle-cry to the followers of the arts and sciences of fish culture -- sometime I must write you anent fish culture being an art -- to divest themselves of the old, outmoded beliefs and practices and embrace the twentieth-century ideas and ideals which are more and more coming into prominence. In a very small way I feel that I have had a part in presenting the more modern aspects concerning sockeye salmon culture and I would that the results which have thus been obtained be impartially reviewed and judged. It is the inevitable role of evolution to change fish culture gradually but nevertheless surely more and more from an art to a science, particularly where large sums of Government money are being utilized, and the elucidation of the cold facts, and the adherence to the results and conclusions thus derived are bound to gain greater prominence and support in the future. Everywhere there arises that same cry "What success are we really achieving?" or "Are we really on the right track?" and without the facts, nothing can be done. The collection of fundamental data is now everywhere the order of the day and until those data are obtained and carefully and impartially analyzed, fish culture must, of necessity, mark time. The cry of the fisherman and angler throughout the land for more and better fish is terrifically insistent and exceedingly penetrating but methinks that in some ways they cry too late. They have allowed our forests to be cut down, our plains to be cultivated, our marshes to be drained, or meadows to be flooded, we have been robbed of our virgin territory where wild-life are wont to abound and yet we are expected to produce the wild-life in even greater abundance than before. Nature herself gave up the struggle against overwhelming and ruthless odds years ago; we think we can bridge the gap but it is only at a cost and time can only tell when that cost will become too great to be longer borne. It seems that we must in many respects back-track a bit, restore some of the natural environment or let it restore itself before we presume to transcend the

laws of Nature and speed up the propagation of natural organisms in relation to the whims and fancies of Man rather than the capabilities and extents of Nature.

I did not intend this letter to become an essay or an utterly sombre sermon on fish culture but one cannot help at times expressing the odd opinion. At a time when organization and planning are the popular pastime it is a distinct pity that organized schemes for fish culture, planned programs for the satisfactory propagation of our commercial and sport fishes cannot be properly put into practice. The need is for fundamental information and the new understanding of fish culture and the biologist and fish culturist must be given sufficient support to obtain the facts and sufficient backing and patient backing to bring the plans and proposals formulated on the basis of the facts to successful fruition.

I apoligize for forcing all this upon you for I am sure you will feel called upon, out of a sense of politeness, to read it through, but I only hope that somehow I may be found to be supporting you and backing you, whether patiently or not I won't disclose, in the very important work which you are directing, not only for the Bureau itself but also for fish culturists generally.

Sincerely yours,

R. E. FOERSTER

Dr. William C. Kendall has called our attention to several unfortunate mistakes in the article on Charles Grandison Atkins in our December issue.

In the second paragraph on page 12 the date of his school teaching given as "from 1862 to 1868" should read "from 1862 to 1863". In the fourth paragraph on the same page "Aquiculture" should read "Aquaeculture", this being the spelling used by Dr. Holmes.

In the first paragraph on page 16, line 7, "small" should read "smolt". Similarly in the last line of the same paragraph "smalls" should read "smolts".

Editor.

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COMMENTS FROM OUR READERS

HAVE YOU ANY FACTS ON THE SUCCESS OF PLANTING FRY?

December 28, 1936.

Mr. Elmer Higgins
United States Bureau of Fisheries
Washington, D. C.

Dear Mr. Higgins:

In a past number of the Salmon and Trout magazine, No. 82, March, 1936, to be more particular, is an article by Edward R. Hewitt in which he assumes to speak for American fish culturists as follows:

"We find in this country that hatchery trout, when grown in the hatchery from two inches up to large fish, do not do as well in the streams as the fish grown from fry in the streams themselves, whether these fry are produced in the hatchery or wild in the streams. Hatchery fry do best when put out with the egg sac on or shortly after absorption without feeding. Larger fish put in our streams lose weight rapidly and rarely amount to anything after spawning."

This statement seems so much at variance with both reports and written statements current in this country that it appears to me it should not go without challenge from some quarter, unless a number of fish culturists have recently changed their minds. A statement of this sort or one to the contrary in order to be worth while or to appear in print in such positive form should be based on a considerable amount of carefully conducted experimentation.

I have not seen any such report. It seems to me that if the above-mentioned statement is born out by facts, it is worth careful consideration. It occurs to me that here might be the background for some discussion which might appear in THE PROGRESSIVE FISH CULTURIST if such discussion can be based on experimental and observational evidence.

Sincerely yours,

J. O. SNYDER

Chief, Bureau of Fish Conservation
Department of Natural Resources
Division of Fish and Game
San Francisco, California

DENMEAD DEFENDS HATCHERY TROUT.

Baltimore, Md.
January 11, 1937

The Editor,

The Progressive Fish Culturist,
U. S. Bureau of Fisheries,
Washington, D. C.

Dear Sir:

I have read with great interest and some profit the article appearing in the December PROGRESSIVE FISH CULTURIST, and while I hesitate to comment, fearing such will be construed in the way of criticism, I feel constrained to come to the defense of the anglers and some of the State and Federal fish culturists, who I have talked to at their "fish factories"; my remarks, of course, are from an angler and a layman, and in no sense official.

It has always seemed to me that most fish culturists are as much interested in the beauty and symmetry of their fish, as is the angler, and that consciously, or unconsciously, they are continually working towards perfection in the fish they raise by weeding out inferior fish whenever possible; it is true they have in mind the size of their output -- that is their business -- but I never saw any of them deliberately retain for breeding purposes anything but the best they had. As to wiping out their whole breeding stock, and beginning all over again with more select stock, they could not do this if they wanted to; expense and lack of funds prevent many improvements desired by the fish culturist.

As an angler I have had opportunities to examine many trout and other species caught by myself in a number of states; my first trout fishing beginning over 40 or more years ago, was for "natives", and later with trout liberated as fry; in those early days no one stocked with legal sized trout, and rarely with fingerlings. Yet in all these years, I have fished, I have caught a very small number of deformed fish; occasionally, I have taken a trout that showed mouth deformity, but this may have been caused by a rough extraction of a hook; very rarely have I caught a really deformed fish; I do recall one 15-inch brown that had spinal trouble - a hump in the back. On the contrary, I have in the last few years taken brooks, rainbows and browns, many of which were over the legal limit when liberated, that showed perfection in both shape and color; of course, as in the human species, some fish will get fat, others will remain thin; but the average run, if they have been in the streams for any period of time before capture, are of good shape and color; last year I saw the loveliest brook trout, spots and all, caught in Western Maryland, that I ever saw anywhere; I caught a 15-inch rainbow in Bear Creek, Maryland, that in symmetry and color was all that any artist could desire. I got several small browns that were perfect, although I must say, I caught other browns and brooks that lacked coloring, but I do not know how long they had been in the streams.

I don't think I am any different from the average fresh water angler in enjoying and appreciating beautiful and well formed fish; anglers of my acquaintance carefully inspect and exhibit specimens of rare color and form, as well as size; I do not find they are satisfied with just any fish; in fact, I think as a whole they are a finicky lot and hard to please.

Very truly yours,

TALBOTT DENMEAD

President, The Maryland State Game and Fish Protective Association

NOTES AND NEWS

EFFECT OF SOFTENED WATER ON TROUT

AN INTERESTING experiment has recently been concluded at the Alresford Research Station, operated by the Ministry of Agriculture and Fisheries for England and Wales.

To test the effect on the growth of trout of water artificially softened by the zeolie process, two tanks were set up: One supplied with water direct from the River Itchen, the other with softened Itchen water. The same number of trout of about the same size were placed in each tank and fed daily with raw beef liver. It was found that the trout in the unsoftened water remained healthy; those in the softened water died in about a week. Since it was possible that the sudden change from hard to soft water might be responsible for the mortality, the tank was again filled, stocked with fish and supplied with a mixture of softened and hard water, the amount of hard water being gradually reduced. The fish remained healthy so long as some hard water was supplied but died when eventually the tank received only softened water.

It appears, therefore, that trout will not live on a diet of liver in completely softened water, but the addition of only a small amount of hard water (about one-thirtieth of the total quantity supplied) was sufficient to keep the fish alive and healthy.

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